METHOD AND SYSTEM ENABLING COMMUNICATIONS BETWEEN A SWITCHED TELEPHONE NETWORK AND A WIRELESS NETWORK

CROSS-REFERENCE TO RELATED APPLICATIONS

This is the first application filed for the present invention.

MICROFICHE APPENDIX

Not Applicable.

TECHNICAL FIELD

The present invention relates to wireless communications networks and, in particular, to a method and system for enabling communications between a switched telephone network and a wireless network.

BACKGROUND OF THE INVENTION

In recent years, there has been an exponential increase in demand for wireless communications services, which was initiated by the development of cellular telephones. Cellular telephones permit subscribers to initiate telephone calls to other mobile subscribers or fixed stations in the Public Switched Telephone Network (PSTN), or to receive calls from either of those sources. Typically, communications between a subscriber using a wireless transceiver and a called station, is mediated by a Mobile Switch Center (MSC), which functions as a Service Switching Point (SSP) in the PSTN. MSCs control wireless communications with each wireless transceiver operating within a service area covered by the MSC. In order to provide wireless communication services over a large

geographic area, it is common to divide the coverage area of the wireless network into discrete service areas (cells) several of which are collectively served by a respective MSC. MSCs operated by a wireless communications service provider are commonly interconnected by time division multiplexed (TDM) trunk facilities. Each subscriber of wireless telecommunications services is assigned a telephone number by the service provider associated with one of the MSCs. That MSC serves as a home MSC for the subscriber. The address (telephone number) of the subscriber's wireless transceiver is recorded in a home location register (HLR) maintained by the home MSC. Calls directed to the subscriber's address are routed using translation tables in the PSTN to the home MSC.

In order to enhance mobility of the subscriber, the HLR also contains information identifying a current location of the subscriber's wireless transceiver. As the subscriber roams from one cell to another, control of wireless communications with the wireless transceiver is transferred to the MSC serving the cell within which the wireless transceiver is located. The address of the "current MSC" is recorded in the HLR maintained by the home MSC of the wireless transceiver as the current location of the wireless transceiver. With this arrangement, an inbound call destined for a subscriber's wireless transceiver is automatically routed to the home MSC. Upon receipt of the call set-up messages, the home MSC queries its HLR to obtain the current location of the wireless transceiver, and then routes the inbound call to the current MSC, if it is different from the home MSC, in order to complete the call.

This conventional arrangement has a disadvantage in that, as the number of subscribers increases, substantial resources of each MSC become tied-up routing inbound calls to other MSCs to serve roaming subscribers. Additionally, as the number of MSCs increases, the size and complexity of the trunk facilities required to handle the inter-MSC traffic also increases.

In order to address these issues, it is known to designate one of the MSCs as a "Gateway MSC", and route all inbound calls to wireless subscribers through the Gateway MSC. The Gateway MSC uses the call set-up messages for the inbound call to identify the home MSC, and queries the HLR maintained by the home MSC to obtain the current location of the called wireless transceiver. The Gateway MSC can then route the inbound call to the current MSC, bypassing the home MSC if the subscriber is roaming, so that the inbound call can be completed without requiring resources of the home MSC. This solution helps to reduce congestion in the mobile network. However, it also tends to increase the size and complexity of the interoffice trunking network because each MSC must be connected to a Gateway MSC in addition to being interconnected with the other MSCs. In addition, since all inbound traffic is routed through the Gateway MSC, congestion of trunks associated with the Gateway MSC is also increased as demand for wireless communications services grows.

Co-pending and co-assigned United States patent application number 09/158,855, filed September 23, 1998 and entitled TRANSIT TRUNK SUBNETWORK SYSTEM teaches the connection of SSPs to a broadband packet network (e.g. an Asynchronous Transfer Mode (ATM) or Internet Protocol (IP) backbone) which provides dynamic trunking between the SSPs

over Switched Virtual Circuits (SVCs) set up through the broadband packet network. The application also teaches that the broadband packet network can be used for trunking between MSCs of a wireless network, thus providing a means of dramatically simplifying inter-MSC trunking by replacing interoffice TDM trunks with broadband packet network facilities. However, this solution relies on a Gateway MSC through which inbound calls are routed in order to enable identification of home MSCs and querying of the associated HLRs to determine a current location of called wireless subscribers. The Gateway MSC therefore becomes a bottleneck to traffic handling as the number of mobile subscribers increases. Alternatively, the Gateway MSC functionality may be distributed among the MSCs in the wireless network. However, this solution has a disadvantage in that the Gateway MSC functionality must be installed and maintained in each of the distributed Gateway MSCs. This contributes to operating overhead and capital expense.

Accordingly, there exists a need for a low cost and highly scalable means for enabling communications between wireline and wireless subscribers.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a method and system for enabling communications between a switched telephone network and a wireless telephone network in which inbound calls can be routed to the wireless network through any one of a plurality of gateways.

A further object of the present invention is to provide a method and system for enabling communications between a switched telephone network and a wireless network, in which an inbound call entering the wireless

network through an inbound gateway is trunked through a broadband packet network and an outbound gateway to a specific MSC controlling wireless communications with a destination wireless transceiver.

Accordingly, the present invention provides a system for enabling communications between a switched telephone network and a wireless network comprising a plurality of Mobile Switching Centers (MSCs). Each MSC is connected by respective gateways to a broadband packet network used for the transfer of bearer traffic between the MSCs, and controls wireless communications with a respective plurality of wireless transceivers (cellular phones, personal computer with wireless communication capability, etc). The switched telephone network is interconnected by at least one gateway to the broadband packet network for conveying bearer traffic between the wireline network and the broadband packet network. The system comprises a location register and a call manager. The location register is adapted to store, in respect of each wireless transceiver, information identifying the MSC currently controlling communications with the wireless transceiver. The call manager is adapted to query the location register to retrieve the information identifying the MSC currently serving a selected wireless transceiver. The call manager enables a communications path across the broadband packet network between a selected gateway and the MSC.

The invention also provides a method of enabling communications between a switched telephone network and a wireless telephone network comprising a plurality of mobile switching centers (MSCs). Each MSC is connected by respective gateways to a broadband packet network used for

the transfer of bearer traffic between the MSCs, and each MSC controls wireless communications with a respective plurality of wireless transceivers. The switched telephone network is interconnected by at least one gateway to the broadband packet network for conveying bearer traffic between the switched telephone network and the broadband packet network. The method comprises a first step of providing a location register for storing, in respect of each wireless transceiver, information identifying an MSC serving each wireless transceiver at the time of a query. In a second step, the location register is queried to obtain the information identifying the MSC serving a selected wireless transceiver. In a third step, a communications path is enabled across the broadband packet network between a selected gateway interfacing the switched telephone network and a selected gateway interfacing the MSC serving the selected transceiver.

The location register may comprise a centralized home location register (HLR) containing information identifying a respective MSC serving each wireless transceiver in the wireless network. The location register may be co-resident with the call manager, or remote from the call manager. The call manager may be adapted to query the location register via a Common Channel Signaling (CCS) network or via the broadband packet network.

Alternatively, the location register may comprise a plurality of Home Location Registers (HLRs), each HLR being associated with a respective home MSC and containing information respecting predetermined ones of the wireless transceivers. In this case, the call manager is preferably adapted to: select one of the plurality of HLRs; and query the selected HLR via one or more of the broadband packet

network and a Common Channel Signaling (CCS) network. Selection of the HLR can be based on information identifying the selected wireless transceiver.

Preferably, the call manager is connected to a common channel signaling (CCS) network and is assigned a point code to enable call setup messages to be addressed to the call manager for setting up communications paths across the broadband packet network.

For an inbound call to a selected wireless transceiver, the call manager is preferably responsive to call setup messages to set up a communications path across the broadband packet network between an inbound gateway interfacing the switched telephone network and an outbound gateways interfacing the MSC serving the selected wireless transceiver. The call setup messages may be conventional Integrated Services Digital Network User Port (ISUP) messages including information identifying the selected wireless transceiver. The call manager is preferably adapted to query the location register, using the information identifying the selected wireless transceiver, to obtain information identifying the MSC currently serving the selected wireless transceiver. The call manager may be further adapted to send a call set-up message including information identifying the selected wireless transceiver to the serving MSC to enable completion of the call to the selected wireless transceiver, and to send connection request messages to the inbound gateway and the outbound gateway to set up a communications path across the broadband packet network between the inbound gateway and the outbound gateway.

For an outbound call originating from a wireless transceiver, the call manager is preferably responsive to

call setup messages to set up a communications path across the broadband packet network between the gateway interfacing the MSC serving of the selected wireless transceiver and an outbound gateway interfacing the switched telephone network. The call setup messages are preferably ISUP messages including information identifying the MSC serving the wireless transceiver, and a destination address on the switched telephone network. The call manager may be further adapted to select one of the plurality of gateways as the outbound gateway and send connection request messages to the outbound gateway and the gateway interfacing the MSC to set up a communications path across the broadband packet network between the gateway interfacing the MSC and the outbound gateway. Thereafter, the call manager sends a call set-up message over the CCS network to the switched telephone network, to set up a connection across the switched telephone network between the outbound gateway and the destination address.

Selection of the outbound gateway may be made on a basis of geographical proximity to the destination address in the switched telephone network.

BRIEF DESCRIPTION OF THE DRAWINGS

Further features and advantages of the present invention will become apparent from the following detailed description, taken in combination with the appended drawings, in which:

FIG. 1 is a schematic diagram illustrating a prior art configuration of a wireless communications network in which traffic inbound from the Public Switched Telephone Network (PSTN) is routed through a Gateway MSC;

FIG. 2 is a schematic diagram illustrating another prior art configuration of a wireless communications network in which time division multiplexed (TDM) trunking shown in FIG. 1 has been replaced by a broadband packet network;

FIG. 3 is a schematic diagram of a system in accordance with a preferred embodiment of the present invention for enabling communications between a switched telephone network and a wireless network;

FIGs. 4a-b are message-flow diagrams schematically illustrating the principle messages exchanged between the components of the system shown in FIG. 3 for calls inbound from the PSTN to a wireless transceiver; and

FIGs. 5a-b are message-flow diagrams schematically illustrating the principle messages exchanged between the components of the FIG. 3 for calls outbound from a wireless transceiver to the PSTN.

It will be noted that throughout the appended drawings, like features are identified by like reference numerals.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention provides a means of enabling communications between a switched telephone network (e.g. the PSTN) and a wireless communications network. Wireless communications services are currently provided by a number of competing service providers, each of which maintains a respective wireless network providing wireless communications services within a coverage area. As shown in FIG. 1, the wireless network 2 typically includes a plurality of mobile switch centers (MSCs) 4a-d (four of

which are shown in FIG. 1) which are well known in the art. Each MSC 4a-4d controls wireless communications for wireless transceivers 6 (only one of which is shown in FIG. 1) within a respective service area, typically via one or more Base Transceiver Stations (BTS) 8 and, possibly, one or more Base Station Controllers (BSC) 10. In general, each MSC 4 is capable of controlling a plurality of BSCs 10, each of which is capable of controlling a respective plurality of BTSs 8. However, for ease of illustration, only one base station controller 10 and one base transceiver station 8 are shown.

Each subscriber has a Wireless Transceiver (WT) 6, for example a cellular telephone or a personal communications system (PCS), to facilitate wireless communications. Each wireless transceiver 6 is assigned by the communications service provider to a home MSC which maintains a record related to the wireless transceiver in a home location register (HLR) 12a-d.

As the subscriber roams within the coverage area of the wireless network 2, the wireless transceiver 6 may leave the service area of the home MSC 4 and enter the service area of another MSC 4 in the network 2. When this occurs, its record in the HLR 12 is dynamically updated with information concerning the location of the wireless transceiver 6. Typically, this information is an address of an MSC 4 serving the wireless transceiver, which is an MSC 4 that controls the service area within which the wireless transceiver 6 is located. As is known in the art, each MSC also maintains a Visitor Location Register (VLR) 14a-d in which it records information identifying roaming wireless transceivers that are currently within the service area that the MSC controls.

For example, in the arrangement illustrated in FIG. 1, the wireless transceiver 6 may be assigned to MSC 4a as its home MSC. However, the wireless transceiver 6 has roamed into the service area of MSC 4d, and thus the address of MSC 4d will be entered in the HLR 12a as the location of the wireless transceiver 6.

Trunking of inter-MSC traffic is typically accomplished by means of a complex mesh of interoffice trunks 16 that interconnect each of the MSCs 4a-d to each of the other MSCs 4a-4d. In order to reduce resource demand on each of the MSCs 4a-d, a gateway MSC 18 can be provided to handle inbound calls originating in the PSTN and destined for wireless transceivers. Thus, for example, an inbound call destined for a selected wireless transceiver 6, is routed through the PSTN to the Gateway MSC 18. Upon receipt of a call set-up message (e.g. a conventional ISUP IAM message), the Gateway MSC 18 uses information in the call set-up message to find the address of the home MSC 4a of the wireless transceiver 6. The Gateway MSC 18 then queries the HLR 12a maintained by the home MSC 4a (e.g. by means of a conventional query message to the home MSC 14a) in order to obtain information identifying the location of the wireless transceiver 6 (e.g. in this case the address of the MSC 4d). Based on the information identifying the location of the wireless transceiver, the Gateway MSC then routes the inbound call to the current MSC 4d for termination in a conventional manner using the interoffice trunks 16 that interconnect the MSCs 4a-d.

Each MSC 4a-d is configured as a Service Switching Point (SSP) in the PSTN. Thus, an outbound call originating at a wireless transceiver 6 and destined for a

termination in the PSTN can be routed directly from the MSC 4d to the PSTN.

Alternatively, the Gateway MSC functionality can be distributed among the MSCs 4a-4d so that an inbound call destined for a selected wireless transceiver 6, is routed through the PSTN to a predetermined one of the Gateway MSCs 4a-d based on, for example, the home address of the wireless transceiver. Upon receipt of the call set-up message, the distributed Gateway MSC 4a, for example, uses information in the call set-up message to find the address of the home MSC 4d, for example, of the wireless transceiver 6. The distributed Gateway MSC 4a then queries the HLR 12d maintained by the home MSC 4d in order to obtain information identifying the location of the wireless transceiver 6. In this example, the wireless transceiver is in an area served by the home MSC 4d. Based on the information identifying the location of the wireless transceiver, the distributed Gateway MSC 4a then routes the inbound call to the home MSC 4d for termination in a conventional manner.

As shown in FIG. 2, inter-MSC trunking has been dramatically simplified by replacing the interoffice trunks 16 with a broadband packet network 20 as described in the co-assigned United States patent application number 09/158,855. For this purpose, each of the MSCs 4a-d, as well as the Gateway MSC 18, are provided with an interface 22 (e.g. a media gateway (MG)) for converting Time-Division Multiplexed (TDM) Pulse Code Modulated (PCM) signals of the PSTN to a data format of the broadband packet network. One or more additional MGs 24 may also be provided to interconnect additional SSPs 26 of the PSTN to the broadband packet network 20 in order to carry outbound

traffic originating from wireless transceivers 6 and destined for the PSTN.

Inbound calls are routed to the Gateway MSC 18 which determines the address of the home MSC 4a of the called wireless transceiver 6 and queries the associated HLR 12a, as described above with respect to FIG. 1. The inbound call is then routed to the current MSC 4d via a switched virtual connection (SVC) set-up through the broadband packet network 20 by a call manager 28. The detailed inter-workings of the MGs 22 and the interaction between the Gateway MSC 18, the call manager 28, and the MSC 4d to enable routing of signals through the broadband packet network 20 are described in detail in United States patent application number 09/158,855, and is therefore not described in detail.

As shown in FIG. 3, the present invention provides an improved arrangement for enabling communications between the PSTN and the wireless network 2. In accordance with the present invention, the HLR functionality of the Gateway MSC 18 (Figs 1 and 2) is relocated to the call manager 30, thus rendering the Gateway MSC 18 redundant. Elimination of the Gateway MSC 18 enables inbound calls to be routed to the broadband packet network 20 through any SSP 26a-c of the PSTN provided with an MG 24a-c to the broadband packet network 20.

Since inbound and outbound calls may be routed through any of a plurality of MG connections (24a,26a - 24c,26c), points of congestion in the PSTN are reduced and scalability of the wireless network 2 is enhanced. In the embodiment shown in FIG. 3, each of the MSCs 4a-d, as well as the associated base station controllers 10 and base transceiver stations 8, can be of a conventional design.

Similarly, the content and functionality of the respective visitor location registers 14a-d maintained by each MSC 4a-d can be conventional. The home location register 12, which contains information identifying the location of each wireless transceiver 6 in the wireless network, may be distributed among the MSCs 4a-d in a conventional manner. If so, the call server will query the appropriate HLR based on the phone number of the mobile transceiver. Alternatively, the HLR 12 may be consolidated (as shown in FIG. 3) to facilitate access by the call manager 30. A consolidated HLR 12 can be co-resident with the call manager 30, or stored at a remote location and accessed by the call manager 30 through either the CCS network or the broadband packet network 20. The operation of the principle elements of the system shown in FIG. 3 is described below for inbound and outbound calls with reference to FIGs. 4a-b and 5a-b, respectively.

FIGs. 4a-b are schematic diagrams of the principal messages exchanged during the set-up and release of an inbound call connection to a wireless transceiver 6 from a telephone handset 32 connected to a caller served by SSP 34 in the PSTN. In step 100, the telephone handset 32 is operated by a user (not shown) to dial digits to initiate the call. The dialed digits are transmitted over a subscriber loop (not illustrated) to the SSP 34 in a manner well known in the art. On receipt of the dialed digits, the SSP 34 queries translation and routing tables (not shown) to determine how the call should be routed. The translation tables may be local translation tables or may require a query to a Service Control Point (SCP) not shown. After translation and routing (step 102), the SSP 34 determines that the call should be routed to an SSP 26a which can reach the mobile network via the broadband

packet network 20. The SSP 34 therefore formulates an ISUP IAM and forwards it in step 104 to the inbound SSP 26a.

On receipt of the ISUP IAM, gateway SSP 26a queries translation and routing tables (not shown) to determine how the call should be routed (step 106). These translation and routing tables may also be local tables or may require a query to a Service Control Point (SCP) (not shown). On translation, the inbound SSP 26a determines that the call should be routed to a Point Code of the call manager 30 which acts as the entry point to get access to the MSC. As will be understood by those skilled in the art, there may be more than one call manager 30 associated with the broadband packet network 20, each call manager 30 being identified by a unique point code.

The gateway SSP 26a therefore formulates an ISUP IAM and forwards it in step 108 to the call manager 30. On receipt of the ISUP IAM, the call manager 30 translates the dialed number and queries the HLR 12 to obtain information respecting which of the MGCs 4a-4b is currently serving the mobile transceiver, in this example the MSC 4d (steps 110 and 112). The call manager 30 also determines an address (in the broadband packet network) of the MG 22d connecting to the MSC 4d. Consequently, the call manager formulates an IAM Advisory message which it forwards to the MG 22d (step 114). An IAM Advisory message is also formulated and sent to MG 24a via the broadband packet network in step 116. On receipt of the IAM Advisory messages, MGs 22d,24a return IAM Acknowledge messages in steps 118, 120, respectively. On receipt of the IAM Acknowledge messages, the call manager 30 formulates connection request messages which are

forwarded to the respective MGs 22d,24a in steps 122 and 124. The IAM Advisory message sent in step 114 to MG 22d contained the broadband packet network address of MG 24a. Consequently, MG 22d is enabled to set up a connection (a Switched Virtual Circuit (SVC), for example), backwards through the broadband packet network to the MG 24a. This is initiated by sending a SVC request message in step 126. This message is processed by the various elements in the broadband backbone network 20 using methods which are well known to establish an end to end connection. Eventually the message 126 reaches the MG 24a which responds with a SVC acknowledge message in step 128 indicating that the connection has been set up. Again, message 128 is processed by the same elements in the broadband backbone network 20 using methods which are well known. Meanwhile, the call manager 30 formulates an ISUP IAM containing the dialed digits and forwards the ISUP IAM to the current MSC 4d in step 130. On receipt of the ISUP IAM, the MSC 4d may extract the dialed digits and query (step 132) its Visitor Location Register (VLR) 14d to determine whether the wireless transceiver 6 is in fact located within its service area. If the result of the query is affirmative, the VLR 14d returns an enabled signal in a response message (step 134). Otherwise, the MSC 4d returns an ISUP Release message (not shown) to the call manager 30 to end the inbound call connection request. In this example, an affirmative response is returned by the VLR 14d at step 134. Consequently, the MSC 4d sets-up a wireless connection (steps 135a-e) with the wireless transceiver 6 and then returns an Address Complete (ACM) ISUP message in step 136 to the call manager 30. On receipt of the ACM, the call manager 30 sends respective ACM Advisory messages to the MGs 22d,24a in steps 138

and 140. These messages are acknowledged in steps 142 and 144. Meanwhile, the call manager 30 forwards the ACM message to the SSP 26a in step 148 which in turn forwards the ACM message to the SSP 34 in step 148, which connects the local loop that serves the telephone handset 32 to complete the circuit to the MSC 4d.

On successful completion of the wireless connection path with the wireless transceiver 6 (e.g. the subscriber presses a "receive" button of the wireless transceiver 6, at step 150), the MSC 4d formulates an ISUP Answer (ANM) message which it returns to the call manager 30 in step 152. On receipt of the ANM message, the call manager 30 sends ANM Advisory messages to the respective MGs 22d,24a in steps 154, 156 and receives Acknowledgements in steps 158, 160. The call manager 30 then forwards the ANM message to SSP 26a in step 162, which forwards the ANM message to the SSP 34 in step 164. On receipt of the ANM message, the SSP 34 may start a billing record for the call, if appropriate.

After the caller and subscriber have completed the communications session, the caller places their telephone handset 32 "on-hook" in step 166 (FIG. 4b). On receiving the on-hook signal, the SSP 34 formulates an ISUP Release (REL) message which it forwards to the SSP 26a (step 168), which in turn forwards the ISUP REL message to the call manager 30 in step 170. On receipt of the REL message, the call manager 30 sends REL Advisory messages and receives REL Acknowledge messages to the respective MGs 22d,24a (steps 172-178). The call manager 30 then sends the REL message on to the MSC 4d in step 180. On receipt of the REL message, the MSC 4d releases the wireless connection with the wireless transceiver 6 and performs subscriber

billing functions, as required (step 182). The MSC 4d then formulates an ISUP Release Complete (RLC) message which it sends in step 184 to the call manager 30. Meanwhile, the call manager 30 has sent an RLC message in step 186 to the SSP 26a (which is forwarded to the SSP 34, in step 188) and an RLC Advisory message in step 190 to the MG 24a. On receipt of the RLC message in step 184 from the MSC 4d, the call manager 30 sends an RLC Advisory message in step 192 which completes release of resources used in the inbound call connection.

FIGs. 5a-b are schematic diagrams of the principal messages exchanged during the set-up and release of an outbound call connection from a wireless transceiver 6 to a telephone handset 32 connected to a caller-facing SSP 34 in the PSTN. In step 200, the wireless transceiver 6 is operated by the subscriber (not shown) to set up a wireless connection path with the MSC 4d and dial digits to initiate the call in a manner well known in the art. The dialed digits are transmitted over the wireless connection to the MSC 4d, again in a well known manner. On receipt of the dialed digits, the MSC 4d queries translation and routing tables (not shown) to determine how the call should be routed. The translation and routing tables may be local tables or may require a query to a Service Control Point (SCP). On translation (step 202), the MSC 4d determines that the call should be routed to a Point Code of the call manager 30.

The MSC 4d therefore formulates an ISUP IAM and forwards it in step 204 to the call manager 30. On receipt of the ISUP IAM, the call manager 30 translates the dialed number and determines which SSP is to serve as a gateway SSP 26a for the call, in step 206. The call manager 30

also determines the address (on the broadband packet network) of the MG 24a serving that gateway SSP 26a. Consequently, the call manager formulates an IAM Advisory message which it forwards via the broadband packet network to the MG 24a (step 208). An IAM Advisory message is also formulated and sent to MG 22d via the broadband packet network (step 210). On receipt of the IAM Advisory messages, MGs 24a,22d return IAM Acknowledge messages in steps 212, 214, respectively. On receipt of the IAM Acknowledge messages, the call manager 30 formulates connection request messages which are forwarded to the respective MGs 24a,22d in steps 216 and 218. The IAM Advisory message sent in step 208 to MG 24a contained the broadband packet network address of MG 22d. Consequently, MG 24a is enabled to set up a connection (a Switched Virtual Circuit (SVC), for example), backwards through the broadband packet network to the MG 22d serving the MSC 4d. This is initiated by sending a SVC request message in step 220. The MG 22d responds with a SVC Acknowledge message in step 222 indicating that the connection has been set up. Meanwhile, the call manager 30 formulates an ISUP IAM containing the dialed digits and forwards the ISUP IAM to the gateway SSP 26a in step 224. On receipt of the ISUP IAM, the gateway SSP 26a translates the dialed digits and formulates a further ISUP IAM message to the SSP 34 in step 226. On receipt of the ISUP IAM message, the SSP 34 extracts the dialed digits and tests the local loop which serves the telephone handset 32 to determine if the handset 32 is available (on-hook) (step 228). If so, the SSP 34 applies ringing to the local loop and returns an Address Complete (ACM) ISUP message. Otherwise, the SSP 34 returns an ISUP Release message to the outbound SSP 26a (which relays it to the call manager 30) to terminate the

outbound call connection request. In this example, the local loop is determined to be available at step 228. Consequently, the SSP 34 returns an Address Complete (ACM) ISUP message in step 230 to the gateway SSP 26a. This ISUP ACM message is forwarded on to the call manager 30 in step 232. On receipt of the ISUP ACM, the call manager 30 sends respective ACM Advisory messages to the MGs 24a,22d in steps 234 and 236. These messages are acknowledged in steps 238 and 240. Meanwhile, the call manager 30 forwards the ACM message to the MSC 4d in step 242.

When the called telephone handset 32 is taken "off-hook", in step 244, the SSP 34 formulates an ISUP Answer (ANM) message which it returns to the gateway SSP 26a in step 246. The gateway SSP 26a forwards the ISUP ANM message to the call manager 30 in step 248. On receipt of the ANM message, the call manager 30 sends ANM Advisory messages to the respective MGs 24a,22d in steps 250, 252 and receives Acknowledgements in steps 254, 256. The call manager 30 then forwards the ANM message to MSC 4d in step 258. On receipt of the ANM message, the MSC 4d can start the billing record for the call.

After the subscriber and called party have completed the communications session, the subscriber ends the call in step 260 (FIG. 5b). On receiving the "end" signal, the MSC 4d releases the wireless connection with the wireless transceiver 6 and formulates an ISUP Release (REL) message which it forwards to the call manager 30 in step 262. On receipt of the REL message, the call manager 30 sends REL Advisory messages and receives REL Acknowledge messages to the respective MGs 24a,22d (steps 264-270). The call manager 30 then sends the REL message on to the gateway SSP 26a in step 272. The gateway

SSP 26a passes the ISUP REL message to the SSP 34 (step 274) which disconnects the subscriber loop serving the called telephone handset 32. The SSP 34 then formulates an ISUP Release Complete (RLC) message which it sends in step 276 to the gateway SSP 26a. Meanwhile, the call manager 30 has sent an RLC message in step 278 to the MSC 4d and an RLC Advisory message in step 280 to the MG 22d. On receipt of the RLC message in step 282 from the gateway SSP 26a, the call manager sends an RLC Advisory message in step 284 which completes release of resources used in the outbound call connection.

As will be understood by those skilled in the art, calls made to wireless transceivers from wireless transceivers are handled in the same way as described above. Translation tables in the MSCs 4a-d route ISUP IAM messages to the call manager 30. The call manager 30 consults the HLR 12 to determine a current MSC serving the called wireless transceiver and sets up a call path through the broadband packet network 20 between the originating and current MSC.Wireless call completion is thereby facilitated and call routing significantly simplified, regardless of where the call terminates in the wireless or the wireline networks.

As will also be understood by those skilled in the art, although the invention has been described with reference to an Asynchronous Transfer Mode (ATM) broadband packet network, other broadband network protocols could also be used with success. For example, the invention may also be implemented using an Internet Protocol (IP) network, or a Multi-Protocol Label Switching (MPLS) network.

As will be further understood by those skilled in the art, although the invention has been explained with reference to a common channel signaling network used for call control messaging, many other types of signaling network can also be used with success. For example, the signaling network may be an X.25 network, an ATM, IP or MPLS network, or any other data packet network adapted to convey signaling messages between network nodes.

The embodiments of the invention described above are intended to be exemplary only. The scope of the invention is therefore intended to be limited solely by the scope of the appended claims.